

# Assignment 1

**AI1110:** Probability and Random Variables  
Indian Institute of Technology Hyderabad

CS22BTECH11061

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**12.13.4.2** An urn contains 5 red and 2 black balls. Two balls are randomly drawn. Let  $X$  represent the number of black balls. What are the possible values of  $X$ ? Is  $X$  a random variable?

**Solution:** Possible values of  $X$  are as follows -

$$X = \{0, 1, 2\} \quad (1)$$

A random variable is an assignment of real values to each outcome of the experiment. Therefore,  $X$  is an random variable.

Let  $N = R + B$  and  $n = r + b$   
where,

Parameter	Value	Description
R	5	Red balls within N
B	2	Black balls within N
N	7	(R + G)
r	{0, 1, 2}	Red balls within n
b	{0, 1, 2}	Black balls within n
n	2	(r + g)

then

$$\Pr(r, b) = \frac{{}^R C_r {}^B C_b}{{}^{R+B} C_{r+b}} \quad (2)$$

In our case ,

$$R = 5$$

$$B = 2$$

$$N = 5 + 2 = 7$$

$$\text{and } n = 2$$

Now,

$$n = r + b$$

$$\therefore 2 = r + b$$

$$\therefore r = 2 - b$$

Now as  $X = b$

and

$$\Pr(r, b) = \frac{{}^R C_r {}^B C_b}{{}^{R+B} C_{r+b}} \quad (3)$$

$$\therefore \Pr(X = b) = \frac{{}^5 C_{2-b} {}^2 C_b}{{}^7 C_2} \quad (4)$$

So, Probability Distribution of  $X$  can be given as

$$p_X(b) = \frac{{}^5 C_{2-b} {}^2 C_b}{21} \quad (5)$$

where  $b = \{0, 1, 2\}$